Characterization of Laser-Active Glasses by Photothermal and Thermo-Optical Measurements

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Photothermal and thermo-optical measurements have been applied to characterize the performance of Yb:glasses as solid state laser materials. Because of its high saturation fluency, long fluorescent lifetime and broad absorption band Yb:glass is a popular material for high power lasers. At the IOQ Jena, Yb:glass is used as an amplifier material for Terawatt and future Petawatt laser systems. The performance of optically pumped Yb:glass is strongly degraded by both thermal effects due to pump light absorption and refractive index changes caused by population density variation. As electronic and thermal effects compete with each other, it is interesting to measure them separately. With the thermal lens technique we could distinguish between thermooptic and thermoelastic refractive index variation, surface deformation and induced birefringence. Inspecting different Yb:glass specimens by pulsed probe beams of different wavelengths, we could discriminate between thermally induced optically path length variation and beam narrowing due to radial gain distribution. The experimental results support the appropriate design of laser amplifiers as well as the selection of optimum laser materials.